

CLAIMS

What is claimed is:

1. A computer system comprising:
a main sub-system comprising a main control unit, a main volatile memory, and a main non-volatile memory;
a mirror sub-system comprising a redundant control unit, a redundant volatile memory, and a redundant non-volatile memory;
a communication link coupled between said main sub-system and said mirror sub-system; and
an uninterruptible power supply connected to said main sub-system and said mirror sub-system.
2. The system of claim 1, wherein said main sub-system is capable of functioning as a mirror sub-system.
3. The system of claim 1, wherein said mirror sub-system is capable of functioning as a main sub-system.
4. The system of claim 1, wherein a controller is embedded in the memory device.
5. The system of claim 4, wherein said controller is a disk controller.

6. The system of claim 1, wherein said main sub-system further comprises a first communications link enabling communication between said main control unit and said main volatile memory.

7. The system of claim 6, wherein said main sub-system further comprises a second communications link enabling communication between said main volatile memory and said main non-volatile memory.

8. The system of claim 7, wherein said second communications link is a redundant communications link.

9. The system of claim 7, wherein said first communications link and said second communications link comprise a single communications link.

10. The system of claim 9, wherein said single communications link is partially connected to said communications link between said main sub-system and said mirror sub-system.

11. The system of claim 6, wherein said first communications link is a processor bus, a peripheral component interface (PCI) network, an Infiniband network, a local area network (LAN) or a wide area network (WAN).

12. The system of claim 1, wherein said communications link is a

processor bus, a peripheral component interface (PCI) network, an Infiniband network, a local area network (LAN) or a wide area network (WAN).

13. The system of claim 1, wherein said uninterruptible power supply is a battery.

14. The system of claim 1, wherein said main sub-system and said mirror sub-system is each connected to its own uninterruptible power supply, respectively.

15. The system of claim 14, wherein said uninterruptible power supplies are capable of exchanging status information.

16. The system of claim 1, wherein said communications link comprises a first communications link coupled between said main control unit and said redundant control unit, and second communications link between coupled between said main volatile memory and said redundant volatile memory.

17. The system of claim 1, wherein said control unit is a processor, a microprocessor, a controller, a microcontroller or a computer.

18. The system of claim 1, wherein said volatile memory is a random access memory (RAM) or a cache memory.

19. The system of claim 1, wherein said non-volatile memory is a flash memory, a programmable read only memory (PROM), an erasable programmable read only memory (EPROM), an electrically erasable programmable read only memory (EEPROM), a hard disk, a diskette, a compact disk (CD) or a digital video disk (DVD).

20. The system of claim 1, wherein said main control unit periodically stores data from said main volatile memory to a backup memory.

21. The system of claim 20, wherein said backup memory is said main non-volatile memory or said redundant volatile memory.

22. The system of claim 21, wherein said backup memory is selected based on a priority determination, a sensitivity to failure determination, a random algorithm, a round robin algorithm, a weighted round robin algorithm, a least recently used algorithm, a space availability determination or network load balancing determination.

23. The system of claim 1, wherein said main control unit transfers data from said main volatile memory into said main non-volatile memory when said main control unit determines that an external voltage level is less than a predetermined level.

24. The system of claim 23, wherein prior to transferring said data said control unit checks for power failure of said redundant control unit.

25. The system of claim 24, wherein upon detection of power failure of said redundant control unit, all data from said main volatile memory is transferred to said main non-volatile memory.

26. The system of claim 24, wherein if there is no detection of a power failure of said redundant control unit, data not previously backed up is transferred to said main non-volatile memory.

27. The system of claim 1, wherein said control unit transfers data from said main volatile memory into said non-volatile memory when said control unit determines that an external voltage level is approaching a predetermined level.

28. The system of claim 1, wherein said control unit transfers data previously transferred into said main non-volatile memory or into said redundant volatile memory to said main volatile memory when said control unit determines that an external voltage level exceeds a predetermined level.

29. The system of claim 28, wherein data is transferred from said non-

volatile memory or said redundant volatile memory to said main volatile memory, the content of which has been corrupted.

30. The system of claim 1, wherein said main volatile memory further comprises a plurality of volatile memory devices.

31. The system of claim 1, wherein said main non-volatile memory further comprises a plurality of non-volatile memory devices.

32. The system claim 1, wherein said main control unit sequentially shuts off the power to said main volatile memory or said main non-volatile memory after data transfer has been completed.

33. The system of claim 1, wherein said system is a computer system.

34. The system of claim 33, wherein said computer system is a network of computers.

35. A method for transferring data between a main volatile memory and backup memory in a system having a main sub-system and a mirror sub-system, each powered by an uninterruptible power supply, the method comprising:

determining if a main control unit is available, and otherwise waiting until

said main control unit is available;

transferring data from said main volatile memory to said backup memory
when said control unit is available;

keeping record of which data was transferred to said backup memory; and
terminating upon completion of data transfer to backup memory.

36. The method of claim 35, wherein said backup memory is a main
non-volatile memory or a redundant volatile memory.

37. The method of claim 35, wherein said main non-volatile memory
is a flash memory, a programmable read only memory (PROM), an erasable
programmable read only memory (EPROM), an electrically erasable
programmable read only memory (EEPROM), a hard disk, a diskette, a compact
disk (CD) or a digital video disk (DVD).

38. The method of claim 36, wherein said main non-volatile memory
is comprised of one or more non-volatile memory devices.

39. The method of claim 35, wherein said main volatile memory is a
random access memory (RAM) or a cache memory.

40. The method of claim 35, wherein said main volatile memory is
comprised of one or more volatile memory devices.

41. The method of claim 35, wherein said method further comprises ceasing the data transfer upon detection of power failure.

42. A computer program product for enabling a system to transfer data between volatile memory and backup memory in a system having a main sub-system and a mirror sub-system, each powered by an uninterruptible power supply, the computer program product comprising:

software instructions for enabling said system to perform predetermined operations, and a computer readable medium bearing the software instructions;

the predetermined operations comprising:

determining if a main control unit is available, or otherwise waiting until said main control unit is available;

transferring data from said main volatile memory to said backup memory;

keeping record of which data was transferred to said backup memory; and

terminating upon completion of data transfer to backup memory.

43. The computer program product of claim 42, wherein said backup memory is a main non-volatile memory or a redundant volatile memory.

44. The computer program product of claim 42, wherein said main

non-volatile memory is a flash memory, a programmable read only memory (PROM), an erasable programmable read only memory (EPROM), an electrically erasable programmable read only memory (EEPROM), a hard disk, a diskette, a compact disk (CD) or a digital video disk (DVD).

45. The computer program product of claim 42, wherein said main non-volatile memory is comprised of one or more non-volatile memory devices.

46. The computer program product of claim 42, wherein said main volatile memory is a random access memory (RAM) or a cache memory.

47. The computer program product of claim 42, wherein said main volatile memory is comprised of one or more volatile memory devices.

48. The computer program product of claim 42, wherein said predetermined operations further comprise ceasing data transfer upon detection of power failure.

49. The computer program product of claim 42, wherein said system is a computer system.

50. The computer program product of claim 49, wherein said computer system is at least a network of computers.

51. A method for transferring data between a main volatile memory and a main non-volatile memory in a system having a main sub-system and a mirror sub-system each capable of being powered by an uninterruptible power supply, comprising:

determining if the voltage level of the main sub-system is less than a predetermined level;

based on that determination, if the voltage level is less than a predetermined level, checking if the voltage level of the mirror sub-system is less than a predetermined level;

based on that determination transferring all data not previously backed up in said main non-volatile memory from said main volatile memory to said main non-volatile memory, or otherwise transferring only data not previously transferred to a backup memory;

determining if said redundant control unit completed transfer of data to said main non-volatile memory; and

based on that determination, turning off the uninterruptible power supply connected to said main non-volatile memory module, or otherwise indicating the completion of data transfer to said main non-volatile memory.

52. The method of claim 51, wherein said uninterruptible power supplies function independently of each other.

53. The method of claim 51, wherein said main volatile memory is a random access memory (RAM) or a cache memory.

54. The method of claim 51, wherein said main volatile memory comprises one or more volatile memory devices.

55. The method of claim 51, wherein said main non-volatile memory is a flash memory, a programmable read only memory (PROM), an erasable programmable read only memory (EPROM), an electrically erasable programmable read only memory (EEPROM), a hard disk, a diskette, a compact disk (CD) or a digital video disk (DVD).

56. The method of claim 51, wherein said main non-volatile memory comprises one or more non-volatile memory devices.

57. The method of claim 51, wherein said transfer of data from said main volatile memory to said non-volatile memory ceases upon detection of voltage level above said predetermined level.

58. The method of claim 51, wherein said system is a computer system.

59. The method of claim 58, wherein said computer system is at least

a network of computers.

60. The method of claim 51, wherein the method further comprises:
determining if the voltage level of the system is above the predetermined level following a shutdown of the uninterruptible power supply; and
based on that determination, turning on the uninterruptible power supply if the voltage level is above the predetermined level.

61. The method of claim 60, wherein the method further comprises transferring the data that was transferred into said non-volatile memory back to said volatile memory if the voltage level is above the predetermined level.

62. The method of claim 60, wherein the method further comprises transferring the data that was transferred into said non-volatile memory to said volatile memory of said main sub-system if the voltage level is above the predetermined level.

63. A computer program product for enabling a computer system to transfer data between a main volatile memory and a main non-volatile memory in a system having a main sub-system and a mirror sub-system, each powered by an uninterruptible power supply, the computer program product comprising:

software instructions for enabling the computer system to perform predetermined operations, and a computer readable medium bearing the software

instructions;

the predetermined operations comprising:

determining if a voltage level of the main sub- system is less than a predetermined level;

based on that determination, if the voltage level is less than a predetermined level, checking if the voltage level of the mirror sub-system is less than a predetermined level;

based on that determination transferring all data not previously backed up in said main non-volatile memory from said main volatile memory to said main non-volatile memory, or otherwise transferring only data not previously transferred to a backup memory;

determining if said redundant control unit completed transfer of data to non-volatile memory; and

based on that determination, turning off the uninterruptible power supply of the non-volatile memory module, or otherwise indicating the completion of data transfer to said main non-volatile memory.

64. The computer program product of claim 63, wherein said uninterruptible power supplies function independently of each other.

65. The computer program product of claim 63, wherein said main volatile memory is a random access memory (RAM) or a cache memory.

66. The computer program product of claim 63, wherein said main volatile memory comprises one or more volatile memory devices.

67. The computer program product of claim 63, wherein said main non-volatile memory is a flash memory, a programmable read only memory (PROM), an erasable programmable read only memory (EPROM), an electrically erasable programmable read only memory (EEPROM), a hard disk, a diskette, a compact disk (CD) or a digital video disk (DVD).

68. The computer program product of claim 63, wherein said main non-volatile memory comprises one or more non-volatile memory devices.

69. The computer program product of claim 63, wherein said transfer of data from said main volatile memory to said non-volatile memory ceases upon detection of voltage level above said predetermined level.

70. The computer program product of claim 63, wherein said system is a computer system.

71. The computer program product of claim 58, wherein said computer system is at least a network of computers.

72. The computer program product of claim 63, wherein said

predetermined operations further comprise:

determining if the voltage level of the system is above the predetermined level following a shutdown of the uninterruptible power supply; and

based on that determination, turning on the uninterruptible power supply if the voltage level is above the predetermined level.

73. The computer program product of claim 60, wherein said predetermined operations further comprise transferring the data that was transferred into said non-volatile memory back to said volatile memory if the voltage level is above the predetermined level.

74. The computer program product of claim 60, wherein said predetermined operations further comprise transferring the data that was transferred into said non-volatile memory to said volatile memory of said main sub-system if the voltage level is above the predetermined level.